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MEDICAL MANAGEMENT OF PERIPHERAL VASCULAR DISORDERS*

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THE four chief conditions in the field of peripheral vascular disease which require the attention of the general practitioner of medicine are arterial embolism, phlebitis, arteriosclerotic disease of the arteries of the extremities, and thrombo-angiitis obliterans. I shall discuss briefly some important considerations in regard to these four conditions.

Most physicians are familiar with the fact that emboli to the extremities generally arise from diseased hearts, but apparently few of them keep this knowledge in mind when handling cardiac cases. This may explain their frequent failure to recognize promptly the occurrence of an embolism to a major peripheral artery. This complication should be anticipated in every case of acute coronary thrombosis and chronic rheumatic or arteriosclerotic heart disease and particularly in those patients in whom the hearts are fibrillating. The physician confronted with a case of heart disease of this type should at once make sure that the normal pulsations in the hands and feet are palpable, and should make a record of any pulsations which are absent. Any complaint of sudden

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numbness, coldness or pain in an extremity should at once arouse his suspicion that an embolism to a major artery has taken place. If this suspicion is confirmed by objective signs, such as loss of pulsation in the vessels, pallor and coldness of the extremity, anesthesia of the foot and muscular paralysis, he should recognize immediately that an emergency has arisen which needs prompt action on his part. It has been my observation that many times precious hours are lost when an embolism occurs, and it is not until gangrene is already beginning to develop that the family physician recognizes that a catastrophe has taken place.

An example of such delay is the following: Some months ago I was asked to see a patient by an experienced specialist in internal medicine. Two weeks previously this patient had had a severe acute coronary thrombosis following which he was desperately ill. Five days before I saw him he complained of numbness in the left foot, but because of the concentration of the physician and nurses on the cardiac problem, little attention was paid to *this* complaint. The numbness persisted and the following day the nurse noted that the foot was cold. After two more days bluish discoloration of the great toe was noted, and this development induced the attending physician to call in a specialist in peripheral vascular disease because he thought there had been a thrombosis of the dorsalis pedis artery. Up to this time no treatment had been directed toward the lower extremity. Because of the use of sedatives for the cardiac condition, the patient had not complained of pain in the leg. Examination showed the left lower extremity cold and cyanotic from the knee down. There was beginning discoloration of the great toe. There was complete paralysis of the leg muscles and complete anesthesia below the middle of the leg. The femoral pulse was present but the popliteal pulse was absent and there was no pulsation in the foot. Obviously, an embolism had lodged at the bifurcation of the common femoral artery, the most favorable location for surgical removal. After five days of delay, necrosis of the tissues was already proceeding rapidly, and it was too late to accomplish anything by medical or surgical therapy. A mid-thigh amputation was the only possible treatment, and in this patient's precarious condition, it carried a great hazard.

Your opportunity to be of greatest help to your patient is lost unless an embolism is recognized immediately after it occurs. Prompt action

should follow, and certain steps should be taken in an effort to prevent gangrene from developing.

The two most common mistakes made in the treatment of embolism are elevation of the extremity and the application of heat. Three out of every five cases of arterial embolism seen in consultation have been treated in this manner. Reflect a moment on the effect of these procedures. An extremity which suffered an embolism has been deprived of most of its blood supply. Is that blood supply increased or restored by elevating the leg? The blood pressure in the extremity distal to the point of occlusion is sharply reduced, and is scarcely adequate to force the blood to the toes. When the extremity is raised, the blood must in addition be pushed up hill. Obviously, elevation of the extremity still further impairs circulation and is harmful. The proper position for an extremity suddenly deprived of its blood supply is sloping downward. When the leg is dependent, the arterial circulation is aided by the action of gravity. The head of the bed should be raised on chairs or blocks so that the level of the feet is below that of the hips. Since the circulation is most precarious in the toes, it is an additional safeguard to turn the patient occasionally so that he lies face down with the feet extending over the end of the bed. In this position the tips of the toes are most dependent.

The second common mistake is the application of heat. The effect of warming tissues is to increase the metabolic rate and to increase the need for oxygen. When the blood supply has been suddenly cut off, these needs cannot be met, and only harm and increased pain result from heating. In many instances gangrene of the foot is due more to the improper use of heat than to the impairment of the circulation. Tissues deprived of nutrition will die, and measures are required to keep these tissues alive until circulation can be restored. It is commonplace knowledge that to preserve meat, we place it in a refrigerator, not in an oven. If we wish to preserve the tissues of an extremity until circulation has a chance to come back, we must apply cold, not heat. The simplest method is to surround the leg with covered ice bags from the toes to the knee or higher if necessary. The beneficial effect of this procedure is at once apparent in the prompt relief of pain. As circulation begins to return, the use of ice bags may gradually be discontinued.

When a major artery is suddenly blocked by an embolism, there is a marked associated spasm of all collateral arteries. Measures to relieve

this spasm are necessary to permit all available blood supply to reach the extremity. The most effective medical means of accomplishing this is by repeated intravenous injections of papaverine. The dosage used is one grain every two hours for four doses, and then every four hours until the circulation appears to be returning safely. Ampules of papaverine should be in every physician's emergency bag ready for immediate use.

Thus, the three measures which should be promptly instituted in every case of embolism are elevation of the head of the bed, the application of cold to the involved extremity, and the intravenous injection of papaverine.

A second method of relieving arterial spasm is by temporary block of the sympathetic nervous system. This can be accomplished by spinal anesthesia, paravertebral block with novocaine, or by continuous sacral anesthesia. Spinal or paravertebral block has the disadvantage that the effect wears off in less than an hour. Continuous sacral anesthesia is a better choice and is destined to be more widely used in the treatment of acute embolic episodes of the legs. If anesthetist and facilities are available this form of treatment should be started immediately.

The surgical removal of an embolism should be considered in every case. Conservative treatment for a few hours is justifiable, but during this interval surgical consultation and preparation for removal to a hospital should be carried out. Best results are obtained if embolectomy is undertaken early, which means within 12 hours after the embolism has occurred. In previous years embolectomy frequently failed because of the formation of a secondary thrombus at the site of operation on the vessel. Much more satisfactory results have been obtained since the use of anticoagulants to prevent such thrombus formation. The intravenous administration of heparin is started before operation and is continued for 48 hours. Dicumarol by mouth is started at the same time, and after 2 days the anticoagulant action of this drug is sufficient to prevent thrombosis and the heparin is discontinued. Operation can be done under local anesthesia and is not a shocking procedure. In recent years reports of successful embolectomies are becoming more frequent.

Embolism to an extremity is a greater emergency than acute appendicitis. The preservation of an extremity and the saving of the individual's life are at stake. Many of these patients succumb to an amputation of a gangrenous leg. Prompt and effective team work is

necessary to save them. Each hospital should have an embolism team consisting of physician, hematologist, anesthetist and surgeon ready to act as a group whenever this type of emergency arises.

If gangrene develops in spite of all measures taken, and an amputation becomes unavoidable, operation should be delayed as long as possible. The purpose of this delay is to allow heart function to improve and to gain time for the development of collateral circulation at the site of amputation. Since most emboli to the lower extremities stop at the bifurcations of the iliac or femoral arteries, the circulation of the thigh is impaired. Amputation is usually done through the mid-thigh region because gangrene of the leg frequently extends almost to the knee. Each day gained allows a better collateral circulation to develop in the thigh. Throughout this period the discolored portion of the extremity should be kept cold, in order to relieve pain and delay the necrotic process. The patient must be watched carefully, and signs of toxemia, such as elevation of pulse and temperature, mental confusion, attempts to get out of bed, and incontinence, should be regarded as indications for proceeding with amputation.

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The treatment of phlebitis is the second topic of this talk. Superficial phlebitis is a benign and relatively simple condition to treat. Inflammation of the superficial veins of the legs is most frequent as a complication of varicose veins, but also occurs as migrating and traumatic phlebitis. The danger of pulmonary embolism is remote as long as the patient with superficial phlebitis is reasonably active. The most common error in treatment is to keep such a patient in bed for weeks. Bed-rest is only necessary for relief of pain, and seldom is required for more than 24 hours. Warm, moist compresses during this period are helpful. As soon as possible the patient should be taught to apply an elastic bandage and should be encouraged to walk and return to normal occupation.

Phlebitis of the deep veins of the lower extremities, on the other hand, is a serious and dangerous condition, often resulting in pulmonary embolism and death, or leaving the patient permanently disabled by a swollen and unsightly leg. It is a frequent complication of operation, confinement, or illness, and should be guarded against whenever a patient is put to bed for several days for any condition. When bed-rest

becomes necessary it is the duty of every physician to make sure that several times each day the legs are uncovered and exercised for several minutes. Flexion and extension of the knees and ankles, movement of the toes, and bicycle exercises will aid circulation in the deep veins of the legs, and prevent a thrombotic process from starting in these veins. The development of a phlebitis in the deep veins of a lower extremity usually can be prevented by proper care.

In recent years it has been generally recognized that the most dangerous period of phlebitis is at the onset, when loose thrombi begin to form in the deep veins of the calf. It is during this time, when there is no swelling and physical signs are minimal, that there is the gravest danger of fatal pulmonary embolism. Complaints of pain in the legs, vague feeling of apprehension, elevation of pulse rate or temperature, tenderness of the calf muscles, pain in the calf on dorsal flexion of the foot, all should be regarded with suspicion as indicating the onset of deep phlebitis. Allen of Boston stresses that a slight simultaneous rise in temperature, pulse and respiratory rate in a previously level clinical chart is strongly suspicious of a pulmonary infarct, and should at once direct attention to a possible phlebitis in the legs.

Several American surgeons now advocate immediate ligation and division of the superficial or common femoral vein as soon as there is any suspicion of thrombosis or phlebitis in the calf veins. Credit for this bold attack on the problem goes to Dr. John Homans, and it has been carried out in hundreds of cases in the Massachusetts General and Boston Beth Israel Hospitals. Dr. Allen at the former institution insists that ligation should be done only of the superficial femoral, while Dr. Fine at the latter hospital prefers to ligate the common femoral or iliac vessels. In several cases the vena cava has been ligated. All of the Boston surgeons agree that ligation should be done in both legs, even though there is suspicion of thrombosis in only one. This is done to forestall embolism from possible thrombosis in the second leg. At the Massachusetts General Hospital prophylactic bilateral femoral vein ligations are being done on all patients over 65 who are to undergo major surgery even though there is no thrombosis or phlebitis in the legs. It is stated that femoral vein ligation results in very little, if any, persistent swelling of the legs.

Experience has shown that even bilateral femoral vein ligation is not an absolute safeguard against pulmonary embolism, for in several

cases fatal or non-fatal emboli occurred in spite of this procedure. Such emboli arise from pelvic or other veins, or from the right side of the heart. Furthermore, the statement that little, if any, persistent edema results from this operation should be accepted with reserve. To cite a single example: I recently saw in my office an unhappy young woman of 27, who gave me the following history: Last July she gave birth to her first child. Her obstetrician said nothing to her about the importance of exercising her legs during the postpartum period. Nine days later she developed severe pain in the chest and a diagnosis of pulmonary embolism secondary to phlebitis was made. Immediately, a bilateral femoral vein ligation was done. She remained in the hospital for a month with her legs constantly elevated. Ever since there had been marked swelling of both legs, which increased during the day to such an extent that her legs bulged over her shoes. She complained of constant dragging pain in the legs and fatigue due to the weight. Examination disclosed a physically perfect body except for the legs. Both lower extremities were enormously swollen, one more than the other. The measurements of the calves were 44 cm. on one side, 40 cm. on the other. The average normal measurement of the calf in a female patient of her size would be 34 cm., so that in this patient there was 10 cm., or 4 inches of swelling on the worse side, and 6 cm., or 2½ inches on the other side. These measurements were made in the morning, at a time when the swelling would be reduced by rest during the night. Similarly, her ankles measured 31 cm. and 26 cm. Normal average readings would be 23 cm. Thus, the worse ankle was 8 cm., or over 3 inches too large, while the better ankle was 3 cm., or over 1 inch swollen. The extremities were so unsightly and conspicuous that she is condemned to the indefinite use of slacks to conceal them. Perhaps this could have been avoided by the simple precaution of regular postpartum exercise of the legs. In any case it was an example of massive edema of both legs following femoral vein ligation, a condition which the proponents of this operation claim does not occur.

Opposed to the use of vein-ligation in thrombosis and phlebitis of the calf veins are those who advocate the use of anticoagulants, heparin and dicumarol. Many hundreds of cases have now been treated with anticoagulants, particularly at the Mayo Clinic, and numerous favorable reports are being published. For example, Barker and his associates of the Mayo Clinic report a series of 1000 surgical cases treated with

dicumarol. These cases were specially selected because they had already had thrombosis or embolism, or were to undergo operations in which this complication was prone to develop. Included were 180 patients who had had a non-fatal pulmonary embolism. In the entire series of 1000 patients only one fatal pulmonary embolism occurred. Such figures cannot fail to be impressive.

The great advantage of the anticoagulant method is that thrombosis and phlebitis are controlled in all parts of the body and not just in the legs. Additional operations are avoided, and the inevitable tendency to swelling of the legs from the thrombophlebitis is not aggravated by further surgical ligations. The dangers of this method of treatment are from bleeding; in wounds, in ulcerative lesions of the gastrointestinal tract, or by hemorrhage into vital organs. In the report from the Mayo Clinic previously cited, there were 25 instances of major bleeding, and 39 of minor bleeding. For the present no one should undertake to give dicumarol to a patient without the constant help and advice of a competent hematologist, who can make the necessary prothrombin time tests and who is aware of the contraindications to its use. If dangerous bleeding should occur he will be prepared to treat the patient promptly with transfusions of fresh whole blood or by injections of vitamin K.

European physicians have long been using another conservative method in treating thrombosis and phlebitis in the calf veins, and this is the application of elastic bandages from the toes to the hips while the patient is in bed. The effect of binding the legs snugly is to compress the deep veins, thereby fixing any thrombus and preventing its free movement. This method may be combined with the use of anticoagulants.

It is generally agreed that when obvious swelling of the extremity develops, the danger of pulmonary embolism is greatly diminished, and ligation of the femoral vein is no longer recommended. The purpose of treatment in this stage is to relieve pain and reduce swelling. Elevation of the extremity and the application of warm, moist compresses or dry heat have been the standard methods of treatment. These are logical and correct forms of therapy. Elevation of the leg helps to reduce venous stasis and swelling, and the application of heat tends to overcome any associated arterial spasm. Guarded exercise of the affected leg is desirable, as this is a form of physiological massage which tends to reduce swelling. It is particularly important to exercise the unaffected

leg regularly, to forestall any tendency to thrombosis and phlebitis in this leg. It is a mistake to keep patients in bed too long. As soon as pain has subsided and the temperature has become normal, an elastic bandage should be applied to the affected leg and the patient should gradually be made ambulatory. A normal sedimentation time is additional evidence that the active inflammatory process has terminated. Bed-rest beyond this point has the disadvantage that it favors development of phlebitis in the other leg.

Repeated paravertebral injections of novocaine to block the sympathetic nerves have been recommended as a form of treatment during this stage of phlebitis. It is claimed that more rapid fall of temperature, relief of pain, and reduction in swelling results from this form of treatment. The technique is relatively simple and the injections can be given at home by anesthetists familiar with the method. Unless there is some contraindication, this form of therapy is worth a trial.

Anticoagulants may properly be used in this stage of phlebitis, both to limit the thrombosis in the affected leg, and to prevent extension of the process to the other leg. I am deliberately avoiding discussion of dosage and method of administration of dicumarol lest you be tempted to use it without proper safeguards. The hematologist will know its dangers, and without his help it would be hazardous to use it.

The discussion of phlebitis thus far has been concerned with treatment of the acute phase. There remains to be considered the proper care of the later stage, which might be regarded as chronic phlebitis, but which should rather be thought of as the sequela of acute phlebitis of the deep veins. Such patients come to the physician for relief of the discomfort of a heavy, swollen, unsightly extremity. The essential cause of the persistent disability is the residual venous stasis which results from partial obliteration of the deep venous circulation. This group of patients is important from a medico-legal standpoint. Many workmen operated upon for injuries occurring during employment develop a postoperative thrombophlebitis. Not only are they disabled by the pain and feeling of fatigue in the swollen leg, but frequently recurring phlebitic ulcers require hospitalization and prolonged medical care. Such patients are a plague to insurance carriers, who must frequently pay unemployment compensation and medical bills for several years.

Treatment must be directed toward diminishing venous stasis. The three available methods are elevation of the extremity, muscular activity,

and external support. Patients who suffer from this condition should be instructed to sleep with the leg elevated, and to elevate the extremity at least to the horizontal for several periods during the day. The most effective method of keeping the leg elevated during the night is to raise the foot of the bed. During the day female patients can usually arrange household work to allow several periods of rest during which elevation of the leg can be carried out. Standing for long periods in one position or sitting with the leg dependent adds to venous stasis and should be avoided.

However, all forms of activity which cause active contractions of the muscles of the legs are beneficial and should be encouraged. Contraction of muscle has the same effect as squeezing a sponge. Local venous pressure is raised and venous return flow is accelerated. The beneficial effects are quickly noted by the patient, pain is relieved and swelling tends to be reduced. Walking, dancing, swimming, riding bicycle, playing tennis, basketball and other active games should all be encouraged. It is a common mistake for physicians to prescribe rest.

The use of elastic support, either in the form of a fitted stocking, or properly applied elastic bandage is the third of the three measures useful in this condition. Such a support acts as a resistance against which the actively contracting muscles exert pressure. The effect of the combined action is to force the venous blood out of the leg. Under the stimulus of such action, collateral venous channels develop in the deeper structures of the extremity, and a more competent venous circulation is restored.

The physician is often confronted with complications which result from the patient's failure to carry out the simple measures outlined. Such complications are dermatitis, chronic cellulitis, and ulceration of the legs. It is a frequent experience to find that patients with such lesions are treated for weeks and months without success. Various types of lotions, ointments, dyes and drugs are applied, and all types of elastic, semi-elastic and rigid bandages are employed. The quickest way to clear up such a complication is to put the patient to bed with the leg elevated. The simplest type of dressing, such as warm, moist compresses followed later by bland ointments are applied. It is seldom that more than three to four weeks are necessary to heal any such superficial lesions. Ambulatory treatment of such cases should be avoided. It is expensive, time consuming, and frequently futile, and the chief result is damage to the physician's reputation.

Turning now to our third topic, the management of patients with arteriosclerotic peripheral vascular disease, we face the largest problem in this field. The many causes of arteriosclerosis, age, diet, hypertension, diabetes, gout, endogenous and exogenous poisons, are causing a constant increase in cases of this type. Most patients come to the physician because of increasing limitation in the ability to walk, but many seek aid because of rest-pain, ulceration or gangrene of the toes or feet.

The simplest type of case is the patient whose only complaint is that he must stop every block or two because of recurring pain in the calf or foot. Such a patient presents a general and a local problem. The symptoms in his leg are due to arteriosclerosis which is part of a generalized disease. What factors are responsible for the arteriosclerosis and what can be done about it? A careful history and complete physical examination may reveal an unsuspected hypertension or sugar in the urine due to uncontrolled diabetes. Tophi in the ear lobes may point to gout. Xanthomatous skin lesions will suggest a high cholesterol in the blood. A history of syphilis may be obtained. The patient may be forty or fifty pounds too heavy, revealing lack of judgment or understanding about eating habits. The careful physician will follow through any clues obtained as to the cause of the premature arteriosclerosis, and will supplement his physical examination with appropriate laboratory studies. He will then be in a position to advise his patient in regard to diet, change in living habits, and specific care of recognized illnesses, all of which are part of the intelligent treatment of his case.

The local problem is relief of the pain in the legs which occurs on walking. This can be solved only by measures which increase the circulation in the extremities. Patients who use tobacco must be convinced that it is necessary to give up this habit completely. Wide experience in the treatment of individuals with arteriosclerotic peripheral vascular disease has demonstrated that smoking aggravates this condition, and that cessation of smoking results in clinical improvement.

The most common error made by physicians in treating patients with this type of peripheral vascular disease is to advise them to spare their legs and walk as little as possible. Physiologists are all agreed that the active use of a muscle results in increase of its blood supply. The end products of cellular activity such as lactic acid and histamine are powerful vasodilators, and their local effect is to increase circulation. Therefore, it may be said that by activity the patient manufactures in

his muscles the most potent medicine which can help his circulation. It is my custom to recommend graded activity of many kinds to patients with intermittent claudication. They are particularly encouraged to walk at a leisurely pace from one to three miles daily, stopping whenever necessary for a few minutes to relieve pain. Walking is advised to and from work, and on every occasion when it is necessary to go from one place to another. Such activities as dancing, playing golf and riding a bicycle within reasonable limits are approved. It is a common experience to have patients report that as they continue to walk they are able to go further and further distances without pain. Considerable time may be required to carry out such activity but the persistent patient will be rewarded by steady improvement in walking.

The use of heat has an important place in the treatment of arteriosclerotic peripheral vascular disease. General heating of the body causes the peripheral blood vessels to dilate, bringing more blood to the extremities. The local effect of heat is to increase the metabolic activity of the cells resulting in increased production of lactic acid and histamine. These are active vasodilators which aid in increasing local circulation. Thus, both general and local heating have value.

The simplest, safest and cheapest form of heat therapy is the warm tub bath. It combines the benefits of both general and local heating. Patients should be instructed to take tub baths at body temperature for one-half to one hour once or twice daily. A pound of epsom or sea salt should be added to each bath as this tends to lessen skin irritation.

Dry heat applied with a baking apparatus or by diathermy is also valuable, but care must be used to avoid over heating. When tissues poorly supplied with blood are heated to over 100° F. burns frequently result. Furthermore, heat is effective in direct relation to the period used. A temperature between 90° and 95° F. maintained for several hours is an effective and safe form of treatment. Such treatment is best given during the night when the patient is normally inactive. For this purpose a specially constructed heater regulated by a thermostat is employed. Such apparatuses are relatively inexpensive and are available. Sleeping under such a heater gives the patient an effective eight hour heat treatment every night.

The value of drugs in the treatment of arteriosclerotic peripheral vascular disease has not been established. As in the treatment of coronary sclerosis, the use of theobromine or aminophyllin combined with

phenobarbital is recommended, although evidence that benefit results is difficult to establish. Potassium iodide is given in combination with these, and all three drugs are best prescribed in enteric-coated pills or capsules. Individual tolerance varies a good deal and the dosage must be adjusted to each patient.

Injections of various expensive biological products such as pancreatic extract (depropanex), testosterone, and tetrathione are highly recommended by their manufacturers, but there is little scientific evidence to support their claims. For the patient whose only complaint is intermittent claudication, their use will be disappointing. The same can be said about the use of the expensive suction-pressure glass boot and the other types of apparatus which employ the same principles.

It is important that the general practitioner should take an optimistic attitude toward the possibilities of improvement in patients with arteriosclerotic peripheral vascular disease, and he will find that his optimism is justified. Much harm is done to the morale of patients by professional pessimism. In the treatment of patients with peripheral vascular disease, just as in those with acute illnesses like pneumonia and typhoid fever, it is well to remember that nature is on the side of the doctor, and considerable spontaneous improvement may take place. Collateral circulation gradually develops to take the place of occluded vessels in many patients. When, in addition, the few simple methods outlined are faithfully carried out, improvement will result in a surprisingly large number of cases.

It is useful to point out briefly the value of hypertension in patients with peripheral vascular disease. In general, it may be stated that high blood pressure tends to protect such patients from serious complications. When sudden occlusion of a major extremity artery occurs due to thrombosis or embolism, gangrene is less likely to take place when the blood pressure is elevated than when it is low. I have frequently observed that in patients with peripheral vascular disease the circulation in the legs tends to improve if hypertension develops. On the contrary, when patients with impaired circulation in the legs and long standing high blood pressure suffer a coronary thrombosis, the associated fall in pressure may precipitate gangrene of the foot.

When arteriosclerotic peripheral vascular disease reaches the stage of ulceration or gangrene, the problem becomes much more difficult. Pain is present not only during activity, but also at rest, and may be

severe. The local destructive process may be progressive and the loss of the extremity is frequently threatened. The serious nature of the lesion must be recognized, and the patient should be confined to bed. When necessary, crutches should be used to avoid weight bearing on the affected foot. The head of the bed should be elevated to aid the flow of blood into the lower extremities. Pain must be relieved by medication, and aspirin, codeine, and morphine may be necessary. Sometimes small intravenous injections of typhoid vaccine to produce slight febrile reactions may be used to relieve pain. The local use of heat frequently aggravates pain, and it should then be discontinued. Instead, local cooling with covered ice bags may give relief. Occasionally, methods to produce venous stasis, such as ligation of the femoral vein or the application of an intermittent venous occlusion apparatus has value in aiding the healing of ulceration.

The diabetic patient with advanced arteriosclerotic peripheral vascular disease presents a special problem because of his susceptibility to infection. In such patients gangrene may develop and involve only a portion of one toe. If such a limited area of gangrene can be kept free from infection, spontaneous demarcation and separation of the necrotic tissue may take place, and loss of the extremity may be prevented. However, unless meticulous attention to detail is observed, infection readily takes place at the junction of living and necrotic tissues, and quickly travels along tendon sheaths or lymphatic channels. Immediately, what appeared to be a minor trouble, suddenly threatens the loss of the patient's leg and may cost him his life. Particularly in the patient with diabetes, any local ulcerative or gangrenous lesion should be treated seriously. Weight bearing must be strictly forbidden, smoking must be stopped, the diabetes must be carefully controlled so that there is no glycosuria, the local lesion must be carefully sterilized and covered with an adequate sterile dressing, and measures to improve the circulation must be instituted. In addition, penicillin should be used locally and given by injection as a safeguard against spreading infection. If for any reason penicillin cannot be used sulfadiazene should be given in adequate dosage.

If conservative treatment results in evidence of improvement, it should be continued, but failure of improvement to take place after several months should be bravely recognized by both physician and patient. There is no greater mistake than to continue futile conservative

treatment in a patient with spreading gangrene until his general condition deteriorates to the point where he cannot survive an amputation. Yet such tragic mistakes in judgment are frequently seen. While the loss of an extremity cannot be regarded lightly, it is still possible for a patient to adjust himself to it and lead a comfortable and fairly active life.

When amputation becomes necessary the level of operation requires serious thought. In most cases local operations to remove one or more toes, or a portion of the foot, will fail. Usually, gangrene of the operative wound promptly develops and spreads, and a higher amputation becomes necessary. Most surgeons recommend amputation through the lower part of the thigh. Satisfactory healing at this level can always be anticipated, but the loss of the knee joint adds greatly to the patient's disability. In most instances amputation can be performed through the middle of the leg, saving the knee joint and about six inches of the leg. A guillotine type of operation leaving the wound wide open for drainage is usually employed. An artificial leg can be fitted to such a stump and the patient can then walk very well steadied by the use of his own knee joint. The operative mortality is much lower when amputations are done through the leg instead of the thigh, and the resulting stump is seldom painful. Recently, the published figures of many of the large hospitals of New York, Philadelphia and Boston, reporting the mortality after thigh amputations were summarized: Of 637 diabetic patients subjected to mid-thigh amputation, 300 died, a mortality of 47 per cent. In contrast, in 110 unselected diabetic patients treated by mid-leg amputation by myself or under my direction, there have been only 8 deaths, a mortality of 7 per cent. In view of the many advantages, I have been recommending mid-leg amputations in nearly all cases for several years.

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The final subject of this talk is the treatment of thrombo-angiitis obliterans. The first symptom of this condition may be an attack of superficial phlebitis, or pain in a toe which is mistakenly attributed to an ingrown toe nail, or pain in the calf muscles on walking a few blocks. With progression, these symptoms become intensified, and later ulceration or gangrene of the toes may develop. Finally, the spread of gangrene and persistent pain may lead to amputation of the leg. This curious disease has been steadily increasing in frequency during the past fifty

years, and cases may be encountered in any general practice. It is a condition which occurs in young individuals, chiefly between twenty and forty years of age. Ninety-nine per cent of the patients are male, but typical examples are occasionally seen in females. All nationalities and races are affected. The use of tobacco by individuals susceptible to this substance causes the disease.

A patient with thrombo-angiitis obliterans must be persuaded to give up smoking completely and permanently. It is useless to treat him unless he coöperates wholeheartedly in this respect. Many patients continue to smoke in spite of repeated warnings that it will result in the loss of a leg. In part, this is due to unwillingness to believe that they have a special susceptibility to tobacco which most people do not share. In part, it is due to the attitude of physicians who disparage the advice of experts in this field and suggest that it will be sufficient to *reduce* the amount of smoking. When gangrene finally develops it is frequently too late to prevent loss of the extremity. The most important part of the treatment in an individual who has thrombo-angiitis obliterans is to make certain that he has absolutely stopped smoking.

Since most patients with this disease are young, considerable spontaneous improvement in circulation often results when the etiologic factor is removed. To speed up the return of circulation, many methods of treatment are available and some of them were outlined in discussing the treatment of arteriosclerotic peripheral vascular disease. However, the most effective treatment is the repeated intravenous injection of hypertonic salt solution. The technique of saline injections is as follows: The solution used is 5 per cent sodium chloride. It is prepared in freshly distilled water, filtered, and immediately sterilized. Since bacteria grow rapidly in distilled water, immediate sterilization is important to avoid contamination. If injections are followed by chills or temperature reaction, the cause is almost always found in failure to follow this rule. Injections are given by the gravity method into a superficial vein at the elbow. Occasionally, when the arm veins are very small, the external jugular vein is employed. The initial dose is 150 cc. and all subsequent injections are 300 cc. The fluid is allowed to run in fairly quickly, only about ten minutes being required for the injection. During this time patients are kept lying flat. While the treatments are being given, patients become very thirsty and many of them experience a sensation of warmth. They are allowed to get up as soon as the injections are fin-

ished and may return to work. One of the great advantages of this method of treatment is that it is ambulatory and it does not interfere with employment. The injections are at first given on alternate days three times a week, later twice a week, and the length of intervals is further increased as the patients improve. The total duration of treatment varies from six weeks to two years, depending upon the severity of the individual case. Patients are discharged when all symptoms have disappeared or when the maximum possible improvement has been obtained.

Patients with ulceration or gangrene require bed rest, and in such cases pain may be severe. If codeine or small doses of morphine fail to relieve pain, repeated intravenous injections of typhoid vaccine sufficient to produce mild fever may be more effective. Care should be used to avoid temperatures higher than 101 degrees, as excessive fever may induce further thrombosis. Occasionally, severe and persistent pain requires more energetic treatment, and in such cases exposure and section of the sensory nerves of the foot is immediately and completely effective. The nerves to the foot can be exposed by short vertical incisions just above the ankle. The nerves are sectioned and immediately sutured. By this means complete anesthesia of ulcerated areas can be produced, and such anesthesia will last for six months to a year. During this period the ulcers can be cleaned and dressed without pain, and they will usually be healed before sensation returns. By dividing the nerves low down in the leg, fibers going to the calf muscles are spared, and there is no interference with muscular activity and walking. Trophic changes in the foot do not occur, and healing of ulcerations appears to be accelerated. This operation should not be undertaken until other methods have been tried without success. Operations done in tissues with poor blood supply may result in poor healing and further complications.

More than 900 patients have now been treated during the past twenty-three years by intravenous injections of 5 per cent saline solution. Of this number over 800 have improved under treatment, and in the great majority of them treatment is no longer necessary. A careful follow-up record has been kept. Most of them are known to be in good health and are working at various occupations. No patient restored to good condition has ever had recurrence of trouble or required amputation unless he resumed smoking. In the entire group of 910 patients only sixty amputations have been necessary, 6.6 per cent. These were re-

quired only in those patients who were first seen at a stage when extensive ulceration or massive gangrene was already present, or in those who could not be induced to refrain permanently from smoking. If thrombo-angiitis obliterans were always recognized and treated in its early stages, and if patients coöperated by ceasing the use of tobacco when instructed to do so, amputations for this disease could be absolutely eliminated.

When conservative methods fail and amputation is required, the knee joint should always be saved. Since most patients with thrombo-angiitis obliterans are young men who must continue to earn a livelihood, it is particularly important to reduce disability. With an amputation below the knee, a young man can soon walk on an artificial leg without a perceptible limp, and he has no difficulty in finding employment. Amputation above the knee is seldom justified in a patient with this disease.

Many other problems in peripheral vascular disease have not been discussed. These include varicose veins, Raynaud's disease, other types of vasomotor disturbances, and various forms of lymphedema. I have concentrated on the four most common conditions to lessen confusion and to leave with you a few clear principles of treatment.

DISORDERS OF THE SPLEEN WITH SPECIAL REFERENCE TO THOSE AMENABLE TO SURGICAL THERAPY*

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FROM earliest recorded times the role of the spleen in health and disease has been the subject of much speculation and controversy. Notwithstanding the fact that the past thirty years have seen noteworthy advances in our knowledge of this viscus, it can safely be said that it continues to be one of the least understood organs in the body.

In view of these circumstances, it seems fitting to review briefly some of the accepted facts about the spleen which are pertinent to any discussion of its disorders. With this in mind, its structure will be taken up first and subsequently its function.

Structure: The human spleen is an encapsulated, fibrocellular organ, measuring on an average 12.5 cm. in its greatest diameter and having the shape of a flattened tetrahedron. Grossly and microscopically its parenchyma suggests a sponge. This similarity becomes even more apparent when the fluctuations in its size and the obvious elasticity of its capsule are observed in the living subject. Histological examination of the architecture of the spleen reveals it to be admirably adapted to the processes of filtration and concentration of the blood. Receiving its main arterial supply from one of the largest branches of the coeliac axis, it is extraordinarily vascular. Its venous outflow passes through the liver by way of the portal vein. The collateral circulation of the organ, a matter of major importance in certain of the splenopathies, will be mentioned later.

Function: As suggested by its structure, one of the principal functions of the spleen is the filtration and concentration of the cellular and particulate matter of the blood. This can be readily seen in special

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preparations of the living mouse's spleen with the aid of a dissecting microscope and powerful light (Knisely,[1] MacKenzie[2]).

Closely akin to the sponge-like properties of filtration and concentration is the function of storage. Barcroft and his co-workers[3] were among the first to study this important attribute of the spleen. Using dogs as subjects they were able to demonstrate that the denervated spleen is capable of holding as much as 1/3 of the total circulating blood volume of this animal. Furthermore, they found that the normal spleen in dogs contracts in response to such stimuli as fright, shock, hemorrhage, exercise, etc., thus discharging into the general circulation a considerable quantity of stored blood. In the human, similar responses to blood loss, shock, and the injection of epinephrine have been frequently observed at the operating table.

Closely related to these more or less mechanical properties of filtration, concentration and storage are the less well understood effects of the spleen on the morphology and biochemistry of the blood. As a constituent of the reticulo-endothelial system, it seems clear that it plays an important part in the economy of the cellular elements. Following removal of the normal spleen, for example, there is an immediate, though transitory, rise in the blood platelets to a level far higher than that observed after an ordinary laparotomy. From this, and also from the effect produced by its removal in certain of the splenopathies, it is assumed that the spleen is at least in part responsible for the control of the normal platelet level. Similarly, it is known that erythrocytes are destroyed in the spleen, the liberated blood pigments being relayed to the liver for use in the formation of bile and the iron remaining stored in the spleen as hemosiderin.

The fact that in the fetus the spleen plays a hematogenic role is well established. It is also thought that under certain circumstances in the adult this role is resumed, though this is less clear with reference to the erythrocyte series than to the white cell series.

In addition to the foregoing, it is believed that the spleen is concerned in an as yet poorly understood way with immunity and resistance. It should be emphasized, however, that in its every day implication, the resistance of the individual to disease appears to be unaffected by removal of the spleen.

Finally, it is known that this versatile structure is not essential to life. There is good reason to believe, however, that following its removal

TABLE I

SPLEEN CLINIC—PRESBYTERIAN HOSPITAL

	Cases with Splenectomy	*Cases without Splenectomy*
Abdominal Buergers	1	8
Anemia—Aplastic	2	84
Anemia—Cooley's	9	17
Anemia—Sickle cell	2	29
Banti-Extrahepatic—Cavernomatous transformation	5	2
Banti-Extrahepatic—Compression	2	3
Banti-Extrahepatic—Sclerosis of portal veins	5	1
Banti-Extrahepatic—Thrombosis	3	3
Banti-Extrahepatic—Stenosis of portal veins	3	1
Banti-Intrahepatic—Cirrhosis	37	52
Banti-Intrahepatic—Cirrhosis Schistosomal	14	4
Banti-Obstructive Factor Undetermined	27	10
Boeck's Sarcoid	2	6
Cyst of Spleen	1	—
Gaucher's Disease	10	3
Hemolytic Jaundice—Atypical	11	11
Hemolytic Jaundice—Typical	56	20
Hodgkin's Disease	2	172
Leukemia—Chronic Myeloid	1	152
"Normal" Spleen	9	—
Osteosclerotic Myelofibrosis	3	16
Polycythemia	1	110
Purpura—Atypical	10	83
Purpura—Idiopathic Thrombocytopenic	58	26
Sarcoma of Spleen	10	7
Splenomegaly—Undetermined Origin	12	63
Traumatic Rupture of Spleen	15	—
Total	311	883

many, if not most, of its functions are taken over by other organs, notably by those likewise containing elements of the reticulo-endothelial system.

In summary, then, the following facts should be kept in mind as the splenopathies are discussed: (1) The spleen, in health, functions as a filter and reservoir for the blood. (2) It is an important, though not essential, member of the reticulo-endothelial system. (3) Under certain conditions it has the power both of forming and of destroying the

cellular elements of the blood. (4) Its presence is not necessary to the maintenance of life and health. (5) The available knowledge of this organ is still very meager.

In discussing the splenopathies, some overall figures gathered from the files of the Spleen Clinic of the Presbyterian Hospital and Vanderbilt Clinic will be presented. This clinic, headed by Dr. Allen O. Whipple, has now been in existence for some 18 years. Its records include cases undergoing splenectomy at the Presbyterian Hospital as far back as 1916. The longest active follow-up in the material is 26 years.

It should be emphasized that the Spleen Clinic has, from the beginning, been a *combined clinic*, i.e., its membership is made up of both physicians and surgeons. It should also be stressed that the clinic revolves about a central hematology laboratory which is staffed by expert technicians of long experience. The role played by these individuals in both the clinical and investigative work of the Spleen Clinic can not be overemphasized and will become self-evident as this discussion progresses. Therefore, the data about to be presented and the ideas drawn therefrom are in reality reflections from a pooling of common interests and experience.

It will be seen from Table I that the majority of cases subjected to splenectomy fall into three main groups: (1) Hemolytic Icterus. (2) Idiopathic Thrombocytopenic Purpura. (3) Banti's Syndrome, or Congestive Splenomegaly. Before taking up these three entities upon which a large proportion of the interest and investigations of the clinic has been centered, it seems wise to dwell briefly on certain of the other less common, but no less important, splenopathies.

Trauma: A discussion of splenic disorders would be incomplete without mentioning trauma. The spleen, despite its comparatively protected position within the lower margin of the thoracic cage, is not infrequently injured by both direct and indirect violence. Its increased susceptibility to trauma and even to spontaneous rupture, in the larger splenomegalies, should not be overlooked. Indeed, this may of itself constitute an indication for splenectomy in certain splenic disorders such as in Gaucher's disease and in some of the very big malarial spleens.

The obvious danger in the traumatized or lacerated spleen is from hemorrhage. When there is the slightest question as to the existence

of this condition, it is wisest and safest to explore the abdomen without delay. This can be done through a small incision and the presence or absence of splenic damage rapidly ascertained. Removal of the organ is indicated if injury is present. Suture or tamponade of the lacerated spleen is impractical, time consuming, and not to be recommended. Splenectomy is simpler, quicker and more certain.

Another important point that should be kept in mind in this connection is the possibility of delayed rupture of, or hemorrhage from, the spleen. This occasional, but treacherous complication should be remembered in connection with all cases of left upper quadrant trauma. It may ensue anywhere from one to twenty-one days or more post-injury and is generally the result of slow bleeding into the splenic pedicle or beneath the capsule. When the pressure within the hematoma so formed rises sufficiently to cause rupture, hemorrhage into the free peritoneal cavity may ensue, which, if not recognized in time, may terminate fatally.

Infection: Suppurative infection of the spleen is extremely uncommon and is seldom diagnosed prior to operation. Drainage of the abscess or splenectomy, when feasible, is indicated.

Tuberculosis of the spleen, while rare, occurs somewhat more frequently in our experience than suppuration due to the common pyogens. It may involve the organ either in the acute miliary form of the disease or in the chronic generalized glandular variety. In the latter, it can give rise to areas of calcification within the spleen which are readily seen by x-ray.

Malignant Disease: It is surprising how infrequently the spleen is involved in malignant disease. Metastases to the spleen from a distant focus are an extreme rarity, despite the organ's intimate relationship with both the blood and lympathic systems. Primary involvement of the viscus by malignancy is likewise uncommon, if one excludes lymphosarcoma. When the latter is encountered, it is impossible to be sure that the process is actually primary in the spleen. Splenectomy is obviously of little benefit. Radiotherapy on the other hand, is of considerable help in some cases for a variable period of time.

Hodgkin's disease and the leukemias, like lymphosarcoma, can also produce splenomegaly. In the leukemias, especially in the chronic myeloid form, the size of the spleen may reach considerable proportions. Because removal of the spleen is obviously of no help in these

TABLE II

SPLEEN CLINIC—PRESBYTERIAN HOSPITAL—SPLENECTOMIES

	Cases
Abdominal Buergers	1
Anemia—Aplastic	2
Anemia—Cooley's	9
Anemia—Sickle cell	2
Banti-Extrahepatic—Cavernomatous transformation	5
Banti-Extrahepatic—Compression	2
Banti-Extrahepatic—Sclerosis of portal veins	5
Banti-Extrahepatic—Stenosis of portal veins	3
Banti-Extrahepatic—Thrombosis	3
Banti-Intrahepatic—Cirrhosis	37
Banti-Intrahepatic—Cirrhosis Schistosomal	14
Banti-Obstructive Factor Undetermined	27
Boeck's Sarcoid	2
Cyst of Spleen	1
Gaucher's Disease	10
Hemolytic Jaundice—Atypical	11
Hemolytic Jaundice—Typical	56
Hodgkin's Disease	2
Leukemia—Chronic Myeloid	1
"Normal" Spleen	9
Osteosclerotic Myelofibrosis	3
Polycythemia	1
Purpura—Atypical	10
Purpura—Idiopathic Thrombocytopenic	58
Sarcoma of Spleen	10
Splenomegaly—Undetermined Origin	12
Traumatic Rupture of Spleen	15
Total	311

conditions, and if performed may well lead to disaster, it is particularly important to distinguish enlargements of this type from other splenopathies benefited by splenectomy.

Erythrocytic Dyscrasias: While splenomegaly is the rule in polycythemia vera and in Cooley's anemia, splenectomy for either condition is valueless. In sickle cell anemia the reverse of splenomegaly occurs when the disease has been present for a considerable period of time: the spleen atrophies and may disappear altogether. This interesting phenomenon is still completely unexplained.

TABLE III

	Splenectomies	*Died foll. operation*	*Died of Disease*	*Died Other Cause*	*Total Deaths*
Hemolytic Icterus	56	3	1	5	9
Idiopathic Purpura	58	0	4	5	9
Banti's	96	11	28	4	43

Splenopathies Benefited By Operation: As mentioned earlier in this paper, the splenopathies in which the results of removal of the spleen have been most satisfactory are: (1) Hemolytic Jaundice; (2) Idiopathic Thrombocytopenic Purpura and (3) Banti's Syndrome (Table II).

In the first, or hemolytic icterus group, the results of splenectomy have been in general excellent. While there have been three post-operative deaths and five deaths from other causes, there has been but one death from a persistence or recurrence of the disease in a total of 56 cases (See Table III).

The results in the second, or purpura group, while extremely good have not been as uniformly excellent as in Group I. It will be noted that out of fifty-eight patients undergoing splenectomy, there have been four deaths from a recurrence of the disease, and five deaths from other causes, but no operative fatalities.

In the third, or Banti's group, the results, while least satisfactory are definitely encouraging in certain of the sub-groups as will become apparent presently.

Hemolytic (Spherocytic) Icterus: This disease is characterized by a variable jaundice, anemia, weakness, splenomegaly and above all else by the associated finding of the spherical microcyte in the blood.[4] A family history of the condition is usually, but not always, obtainable. In most instances the ailment is first noted in childhood. It runs a chronic course, subject, in the severer forms of the disease, to acute hemoclastic "crises" in which the anemia and jaundice become profound. Of interest is the occurrence of gallstones in 40 to 60 per cent of all cases. These are essentially pigment calculi and are due to the excessive blood pigment released by the increased red cell destruction. Splenectomy effects a permanent arrest in practically all cases.

TABLE IV

	Splenectomies	*Died foll. operation*	*Died of Disease*	*Died Other Cause*	*Total Deaths*
Atypical Hemolytic Icterus	11	4	1	—	5
Atypical Purpura	10	2	3	—	5

As intimated previously, the *sine qua non* of diagnosis rests upon the finding of the spherical microcyte in the blood smear. This is as essential to establishing the identity of this syndrome as the malarial parasite is to malaria. For while increased fragility of the red cells and a reticulocytosis must be present also, splenectomy can be counted upon to be of benefit only when the spherocyte is present too. To put it another way, we have a sizable group of atypical hemolytic icterus cases, similar in almost every respect to the true disease save for the absence of the spherocyte. The results of splenectomy in this group (See Table IV) have been uniformly disappointing: five patients are now dead out of eleven.

Experimental: Spherocytic jaundice can be produced in animals—notably mice—by the intraperitoneal injection of a hemolytic serum prepared by inoculating rabbits with red cells of the mouse. Thus an anti-mouse red cell serum is formed which, when injected into the mouse, produces hemolysis. The spherical microcyte is a phase in the hemolysis of the red cell and is seen in profusion in the experimental animal treated this way. The spleen of the latter rapidly enlarges and on fixed section bears a striking similarity to the histopathology of this condition in the human spleen. Furthermore, when these spleens are studied by the transillumination technique on living mice, it can be seen that the spherical microcyte is selectively filtered from the blood stream by virtue of the fact that its globular shape now prevents it from passing readily from the pulp spaces into the venous sinuses and collecting veins (Whipple[5]). By analogy this would seem to explain Thompson's[6] finding in the spleens of individuals with hemolytic icterus that there is a great increase in the number of spherocytes in the pulp spaces as compared to the numbers found in blood from the splenic vein. The engorgement of the spleen with these cells would, in turn, partially

account for the splenomegaly seen in this condition.

If it is admitted that the spleen destroys these spherocytes, which seems obvious, the explanation of the increased red cell destruction, and hence the jaundice and anemia of hemolytic icterus, is evident. Further evidence in support of the foregoing is found in the fact that following splenectomy in this condition the patient is clinically cured as far as anemia, weakness and jaundice are concerned, but the spherical microcyte persists throughout life. In the only instance of recurrence of this clinical condition following splenectomy in our series, countless small spleens were found scattered about the peritoneal cavity and left upper quadrant at autopsy. We believe that this, in turn, may have been due to the leaving behind of accessory splenic tissue at operation.

Idiopathic Thrombocytopenic Purpura Hemorrhagica: The results of splenectomy in thrombocytopenic purpura are not quite as good as in hemolytic icterus, nor is the disease as well understood, but in the so-called idiopathic variety many brilliant and life saving arrests have been effected by the performance of this operation.

In the adult, this condition is essentially a disease of the female: there are only four instances of its occurrence in males in our entire series of fifty-eight and in only one of these was the patient over twenty when the disease was first noted. In childhood purpura is usually a self-limited condition and is apt to be associated with infection. Splenectomy is generally not necessary in this age group.

The diagnosis of idiopathic purpura is often difficult. It is easily confused with aplastic anemia or aleukemic leukemia. Because it may occasionally be an allergic manifestation, in taking a history, a careful investigation of the possibility of drug idiosyncrasy or exposure to heavy metals should be carried out. Possible foci of infection in the teeth, tonsils or accessory nasal sinuses should likewise be looked for. In this connection it is interesting that we also have on record several instances of thrombocytopenic purpura resulting from, or secondary to, the invasion of the bone marrow by metastatic carcinoma.

In the female, menorrhagia is a frequent and distressing symptom. The most dangerous sign in either sex, however, is evidence of bleeding into the brain as suggested by headache, coma or dimness of vision. While bleeding may occur in any organ or tissue, it is most commonly encountered in the skin and from the nasal, gingival and uterine mucous membranes.

It is of considerable importance to call attention to the fact that in the majority of cases the spleen can not be felt. It is our belief that the presence of a palpable spleen militates against the diagnosis of idiopathic purpura. In a few of the longstanding cases, however, its tip can sometimes be felt. At operation the organ is generally seen to be only slightly larger than normal.

The characteristic blood finding is, of course, a marked diminution in the number of the platelets which may even be absent on direct examination. In addition to this, there is an anemia, which is proportional to the severity of the blood loss, and a prolonged bleeding time. While the clotting time is not abnormal, clot retraction may be delayed. The white blood count is either normal or slightly elevated. If this determination is depressed, one should be immediately suspicious of an aplastic anemia, aleukemic leukemia, or some other underlying condition to which the purpura is secondary. Another important diagnostic aid is the measurement of the state of resistance of the capillaries, which is definitely lowered in this disease. This may be done either by the suction method of Dalldorf or by the tourniquet test. We have preferred the former,[7] inasmuch as the resistance can be more accurately quantitated with it than with the latter.

It has been the policy of the Spleen Clinic to operate upon these patients during a remission of their disease, when possible. One must be prepared to use liberal quantities of blood. Speed is essential during the first part of the operative procedure, or, at least, up until the time that the splenic pedicle has been clamped and the organ removed.

It will be noted that in the atypical purpuras the results have been uniformly poor: five patients out of ten in this sub-group are dead. This is due to the fact that subsequent to operation these patients were discovered to have thrombocytopenic purpuras which were secondary to a previously unrecognized underlying disease. The lesson learned from this group is the obvious necessity for being absolutely sure of the diagnosis before proceeding with surgery.

Banti's Group (Congestive Splenomegaly): Rousselot and Thompson[8] demonstrated the presence of the congestive factor in the etiology of this condition in dogs and have repeatedly emphasized its importance in man. We have broadly classified the cases which fall into the Banti's group into three categories, depending on the location of the site of obstruction. (1) Extra-hepatic obstruction. (2) Intra-hepatic obstruc-

TABLE V

BANTI GROUP SUBDIVIDED

		Splenectomies	*Deaths*
(A)	*Extrahepatic:*		
	(Portal Vein Pathology)		
	1. Cavernomatous Transformation	5	4
	2. Compression	2	1
	3. Sclerosis	5	3
	4. Stenosis	3	2
	5. Thrombosis	3	0
		18	10
(B)	*Intrahepatic:*		
	1. Cirrhosis	37	25
	2. Cirrhosis Schistosomal	14	2
		51	27
(C)	*Cause Undetermined:*	27	6 (3 of other causes)

tion. (3) Obstructive factor undetermined.

Each has essentially the same disease picture—a big spleen, usually hepatomegaly as well, and a blood picture showing depression of all the formed elements of the blood. Ascites and hematemesis are present in advanced cases and of a very poor prognostic omen.

It will be noted from Table V that the results are least satisfactory in the identifiable extra-hepatic group and in the Laennec type of cirrhosis in the intra-hepatic group. Best results have been obtained in those cases in which the obstructive factor was undetermined. In this latter group the liver has been essentially normal in all cases and we believe that this is the reason why the results in this group have been so good. In the Laennec type of cirrhosis group, almost all the patients who are now dead had either hematemesis or ascites. It may well be asked whether operation is justified in this group, when the results of splenectomy are so poor. In order to answer this problem, Dr. Mary White[9] of our clinic compared the length of life in these cases following splenectomy with an equal number of unoperated cases of Laennec's cirrhosis proven at autopsy. She found that those who had their spleens removed lived between 3 and 6 years after the development of evidence

of cirrhosis. On the other hand, in the unoperated series of cases coming to autopsy, the length of life after the development of first symptoms of cirrhosis was only 13½ months. It would seem, therefore, that in this group we are justified in splenectomy, not only as a measure of establishing with certainty the diagnosis but also, obviously, as a method of prolonging life. It should be noted that in the Schistosomal cirrhosis group the results are comparatively good. We believe that the reason for this is the fact that patients with this particular condition show no clinical or laboratory evidence of hepatic insufficiency. At the present time, Doctors Blakemore[10] and Whipple[11] are attempting to short-circuit the obstructed portal system by means of anastamosing the splenic and renal vein, or by the performance of an Eck's fistula. They have performed one or more of these operations fifteen times, with two deaths. As yet the follow-up on these cases is too short to evaluate accurately the results of this type of surgical attack.

Summary

In summary, then, the experience of the Spleen Clinic indicates that the removal of the spleen is followed by excellent results in hemolytic icterus, particularly as far as arresting the disease process is concerned. In the thrombocytopenic purpuras, an arrest may be expected in approximately 85 per cent of the cases. In Banti's syndrome, while the process continues to a fatal termination in the majority of those with an extra-hepatic obstructive factor, or a Laennec's type of cirrhosis, life expectancy is increased from 2 to 5 years in this latter group. In those cases where the obstructive factor is not determined and the liver is normal, and in the group caused by Schistosomiasis, the results are very good providing hematemesis or ascites has not developed prior to operation.

In conclusion, may I emphasize: (1) the importance of studying these diseases in a combined group; (2) the absolute necessity of accurate hematologic data; (3) the inadvisability of delaying surgery, in those groups where it is indicated, once a definite diagnosis has been reached.

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HEMORRHAGE IN THE VIABLE PERIOD OF PREGNANCY*

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VAGINAL bleeding, at any period of pregnancy, is abnormal although it is recognized that there may be some staining in the very early months of pregnancy at the time of the normally expected menstrual period. This may be physiological, before the formation of the placenta. Any bleeding thereafter is abnormal and requires prompt investigation.

I shall confine my remarks, this afternoon, to the management of bleeding during the so-called viable period of pregnancy.

For statistical purposes, the United States Bureau of Census has adopted three criteria for determining the viability of the fetus: (1) 28 weeks, or more, of gestation, (2) a fetus 1500 grams, or more, in weight, (3) a fetus 35 centimeters, or more, in length. It is rare for a baby, not possessing at least two of the above criteria, to survive. There are rare instances in which gestation is apparently slightly less than 28 weeks, or in which the child does not come up to the specifications of weight and length, and yet, with excellent obstetric and pediatric care, including the use of modern incubators and special premature nurseries, such a child has survived.

In 1933 a report on Maternal Mortality in New York City was published by The New York Academy of Medicine, under the auspices of the Committee on Public Health Relations. This report indicated that the maternal mortality rate for New York City was approximately 57 per 10,000 living births. At that time this Committee stated that at least two-thirds of all maternal deaths were preventable. The factor of preventability was assigned to error in judgment or error in technique on the part of the physician or midwife in approximately two-thirds of all maternal deaths. In approximately one-third of the cases, preventability was charged directly to the patient in not seeking or accepting proper obstetrical care.

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Following this report, the Medical Society of the County of New York appointed a Special Committee on Maternal Welfare. I have been a member of this Committee since its formation and, for the past several years, have been privileged to serve as its Chairman. The function of this Committee is to secure and analyze all data relative to ante partum, intra partum and post partum management of all deaths occurring in the viable period of pregnancy.

During the intervening years, I am happy to report, there has been a steady decline in the maternal mortality rate in New York City, and also, that similar Committees are functioning in many of the larger cities and in other less thickly settled districts.

The United States Bureau of Census files, for the year 1929, reported 77 mothers lost per 10,000 live births. In 1944, the United States Bureau of Census files showed a maternal loss of 23.3 per 10,000 live births. And in the same year, the Bureau of Records of the Department of Health for New York City recorded 124,395 deliveries (at 28 weeks of gestation, or over) with 165 puerperal deaths among women who had reached the 28th week of pregnancy. This represents a mortality rate of 13.3 per 10,000 births in the viable period of gestation for New York City. Since the maternal death rate for New York City is not computed on an identical basis with the Census Bureau figures, absolute comparison must not be made. However, a definite trend toward a lowered maternal mortality is evident.

In general, this lowering of maternal mortality in the United States has been due to the marked lessening of death caused by sepsis and the toxemias of pregnancy. In 1943 the Bureau of Census showed, for the first time, that hemorrhage was the major cause of maternal death in the U.S.A. For a number of years hemorrhage had been the major cause of death in New York County, and is still a major, or contributing factor in at least one-half of all obstetrical deaths in New York County.

It is gratifying to note, however, that hemorrhage is being more promptly and adequately treated, largely due to the coöperation and the facilities of the Blood and Plasma Exchange, with its various branches located in the hospitals of New York County. It is still unfortunate that a number of mothers do not avail themselves of the existing facilities for proper prenatal and intra partum care, and it is also unfortunate that obstetricians have not more promptly and completely utilized the excellent facilities of the Blood and Plasma Exchange.

Although the maternal death rate for New York City, during the year 1944, was considerably less than one-third the maternal death rate in 1933, we must concede that it is possible to reduce still further this maternal loss, especially in cases due to hemorrhage. I believe it is fair to say that the greater number of hemorrhagic deaths are preventable, if prompt and adequate measures are taken. I do not consider that all hemorrhagic deaths are preventable.

Vaginal bleeding, occurring at any time during the viable period of pregnancy, requires most careful consideration. Under ideal conditions the bleeding patient should be placed under the supervision of a well trained physician or obstetrician, preferably in a well equipped obstetrical department of a hospital. Minor degrees of bleeding may require no further treatment and the cause itself, whether from cervical erosion, rupture of small varicosities in the genital tract or excess activity on the part of the patient, may be in doubt.

The more serious types of bleeding may be due to: (1) cervical lesions, such as excessive erosions, or malignancy, or, more rarely to a ruptured varicose vein, (2) placenta previa, (3) premature separation of the normally situated placenta, (4) trauma from delivery, with lacerations of the vagina, cervix, or rupture of the uterus, (5) post partum hemorrhage due to uterine atony, fibroids, etc.

Preparation for the control and complete management of the bleeding patient is of prime importance. As soon as the patient presents herself for ante partum care, she should be given a complete physical examination and, in addition, blood should be taken for Wassermann test, hemoglobin content (if this is below 70 per cent a red blood cell count should be made) and the blood should be typed, as to the blood group, and an Rh factor determination should be made. If blood replacement becomes necessary at any time in a mother who is Rh negative, she must receive Rh negative blood. Much valuable time will be saved if the type and Rh factor of the patient is known, prior to the need for transfusion.

Examination for the determination of the cause of bleeding should, of course, be performed under sterile precautions.

Cervical Lesions

Bleeding from cervical erosions, or small ruptured varicosities of the cervix during pregnancy, usually requires no treatment beyond rest or

occasional packing or superficial electro-coagulation. Suspicious areas of erosion require biopsy to exclude malignancy. If malignancy of the cervix is found during the viable period of pregnancy, that pregnancy should be terminated as soon as possible, since it is well known that gestation hastens the growth and spread of the malignant process. Delivery of a viable baby through such a cervix is dangerous. The baby should be delivered by abdominal caesarean section, preferably of the Porro type. The amputation of the uterus should be above the bladder fold of peritoneum and without displacement of the bladder. In from four to six weeks the cervical carcinoma can be treated, in the usual manner, by radium and/or x-ray therapy.

Placenta Previa

Placenta previa is one of the major causes of serious hemorrhage in the viable period of pregnancy. The incidence of this condition is probably about one in two hundred deliveries. In the larger obstetrical services this incidence is somewhat greater. The maternal mortality rate in this condition has been stated to be 10 to 20 per cent. In recent years, however, this has been markedly decreased, especially in the larger obstetrical clinics. A review of the literature would indicate that maternal mortality attributable to placenta previa in the past ten years is approximately 3.6 per cent.

The earliest intimation of placenta previa is painless bleeding. This may be a mere spotting or a profuse hemorrhage. Painless bleeding of even minor degree is a danger signal and should not be disregarded. Any bleeding in the last trimester of pregnancy is abnormal. Vaginal examination under home conditions and without proper facilities to combat hemorrhage and carry out proper treatment is dangerous. The patient should be hospitalized immediately so that sterile vaginal examination, on which final diagnosis depends, may be safely made. This examination should be made only after all is in readiness to control hemorrhage and to carry out the proper method of delivery, the only exception to this rule being profuse vaginal bleeding which may be controlled temporarily at least by vaginal tamponade, preferably with heavy iodoform gauze packing. Upon admission, the patient should be immediately prepared for delivery either vaginal or abdominal. During this time she should have a complete blood count, including a cross matching and Rh factor determination. A suitable, compatible donor or compatible

bank blood should be immediately available in the operating or delivery room. Meanwhile, the patient should receive supportive treatment with pooled plasma, glucose or saline solution, if needed. Rectal examination is unreliable, inconclusive and frequently more traumatic. The risk of increased hemorrhage and possible sepsis involved in vaginal examination has led to the use of x-ray as an aid in the diagnosis of placenta previa. Many obstetricians are still somewhat skeptical of the accuracy of this method. It appears to be particularly valuable in ruling out premature separation simulating placenta previa. Absolute certainty of diagnosis in placenta previa is obtained only from vaginal examination, when the placenta may be felt in the lower uterine segment. The placenta may completely cover the os uteri or may partially cover it. In the less complete type, the edge of the placenta may be felt on the lateral surface of the lower uterine segment when the examining finger is inserted through the cervical canal. Active treatment should be instituted only after the actual diagnosis is made. From the standpoint of treatment, there are two types of previa. Either the placenta covers the os (central or complete previa) or it does not (incomplete, partial or lateral previa). The degree of previa, whether complete or partial, will vary with the time of the examination and the relative dilatation and retraction of the cervix.

In the so-called complete or central previa, there is little disagreement as to the method of treatment, this method being delivery by the abdominal route, some obstetricians favoring the classical caesarean while others adhere to the low flap type of operation. Obstetricians who favor the classical caesarean in cases of central placenta previa apparently do so on the grounds that the incision in the fundus avoids the placental site and thereby lessens blood loss at the time of operation. Other obstetricians favor the low flap type of caesarean on the grounds that the incision can frequently be made above the edge of the placental insertion, or if this is unavoidable, that the hemorrhage caused thereby is rarely excessive. It is a well known fact that the low flap type of caesarean section has a lower mortality rate than the classical section. A study of caesarean section mortality from all parts of the country covering thousands of cases clearly indicates that the mortality rate in the low flap type caesarean is approximately one-half or less than one-half the mortality rate in the classical caesarean section. This is true in all groups of caesarean sections including caesarean sections

done in cases of placenta previa.

When the placenta previa is not complete (probably two-thirds of all cases) opinions as to the method of treatment show considerable variation. An analysis of the literature in the past ten years indicates that two methods of treatment have given the best prognosis for mother and child. These methods are: (1) Simple rupture of the amniotic sac (and await the normal process of labor and delivery per vagina) or, (2) Abdominal delivery by caesarean section. The choice of method will be determined by the individualization of each case indicating to the trained obstetrician the proper method to be chosen. This selection of the method of treatment and delivery should be made at the time of vaginal examination. From this moment on, active treatment should be decisive and prompt. The general condition of the patient (anemia, parity, etc.) and the viability of the fetus are two important factors aside from the type of previa present. There is no expectant treatment of placenta previa. This rule, however, like all others in medical or surgical therapy, is subject to a somewhat liberal interpretation under the careful supervision of a trained obstetrical surgeon. For example, an elderly primigravida, having only slight spotting without labor and the fetus not yet certainly viable, might be given expectant treatment. This treatment being continued hospitalization, supportive treatment if indicated and with everything in readiness for prompt, active treatment should this become necessary.

All types of accouchement forcé are unqualifiedly condemned in the treatment of placenta previa. In the management of this condition the essentials in all cases are to stop the bleeding and empty the uterus as quickly as is consistent with the least contamination, shock or trauma. We must salvage the mother at all costs and the child also, if this is possible and the child is viable.

Other methods of treatment and delivery are extensively used in many of our clinics—Braxton Hicks' version, hydrostatic bag (followed either by forceps or internal podalic version), breech extraction, Willett's forceps or vaginal tamponade during dilatation. None of these methods is free from danger and none has given the low mortality rate, both to mother and child, that has been obtained by the simple rupture of the membranes or delivery by caesarean section. The time of treatment in placenta previa is of paramount importance. Hemorrhage occurs during the stage of cervical dilatation and retraction. This hemorrhage

can be controlled in the great majority of cases by any one of the many methods mentioned or now in general use, the fact being that maternal deaths rarely occur before the delivery of the child since, by any of the methods described, pressure is exerted against the abnormally situated placenta and acts as a tampon to control hemorrhage.

However, when the uterus has been emptied of the child and the placenta, there is a very great tendency to profuse blood loss. The placenta having been attached to the thinned non-contractile lower uterine segment, bleeding continues from the placental site even though the fundus may be well contracted.

In our clinic, we have based our treatment on the avoidance of cervical dilatation and retraction and have found that blood loss, both before and after the emptying of the uterus, is greatly lessened. This avoidance of cervical dilatation can be accomplished only by early caesarean section. If the diagnosis of placenta previa is made, after the cervix is well advanced in dilatation and retraction, particularly in a multipara with a partial or lateral previa and a baby of questionable viability, then vaginal delivery might be chosen, the method of treatment being simple rupture of the membranes allowing the presenting part to descend and make pressure on the placental site.

It has been our practice to insert a tight uterine tamponade in practically all cases of placenta previa immediately following the emptying of the uterus, either from above or below.

Premature Separation of the Normally Situated Placenta

Separation of the placenta from its implantation in the uterine wall results in hemorrhage, either concealed (when there is no escape of blood from the cervix) or manifest (when the blood does escape from the cervix). The incidence of premature separation of the placenta, as determined from a review of the literature, indicates a wide variation since many authors include only the two more severe types, such as ablatio placentae, while others include all degrees of premature separation, many of which are diagnosed only at delivery when there may be an unusual amount of old blood clot found behind the placenta. If all degrees are included, the incidence is approximately one in 150 to one in 200 deliveries, the more severe types accounting for probably less than one-third the total number.

External bleeding may or may not be an early sign of premature separation of placenta. As the condition progresses there is increased uterine tension causing pain. With the increased retroplacental accumulation of blood, the uterus becomes irritable, the contractions continue until, in the fully developed ablatio placentae, the uterus assumes complete tonicity. Pain is continuous and there is no relaxation of the uterine contraction. The patient may show shock out of proportion to the visible blood loss. Some of the more severe cases of premature separation of placenta show little or no external bleeding until late in the management of the condition. A review of the literature for the past ten years indicates a maternal mortality ranging from 5 to 10 per cent although many larger clinics are able to show a maternal loss of not over 3 per cent. Undoubtedly all maternal loss from this condition occurs in the group of extensive premature separation. This group would include not more than one-third of all cases classified as having premature separation of placenta.

Vaginal bleeding or uterine tonicity and pain are indications for prompt hospitalization. The severity of the symptoms, pain, shock, tonicity of the uterus, the parity of the patient and the evidence of hemorrhage, either concealed or manifest, will determine the method of treatment. In the mild cases, expectant treatment under constant hospital supervision is the method of choice. In all cases, however, the patient should be prepared for delivery, either vaginal or abdominal. Supportive treatment with plasma, glucose or saline should be given as indicated. Complete blood count should be done and all preparations made for the replacement of blood when needed. Repeated blood counts and blood pressure readings, pulse rate, etc. will indicate the progress of the condition. A compatible blood donor or bank blood must be immediately available in the hospital. Sedation with opiates for the control of pain is definitely indicated. The obstetrician, however, must be constantly on the alert that he be not lulled into a false sense of security from the apparent improvement of the patient due only to the relief of pain, while the underlying causes with increasing hemorrhage and infiltration of the uterine musculature become progressively more severe. In many of the milder cases of premature separation of placenta the area is small and does not progress. Frequently, there is a moderate loss of blood and the uterus shows some evidence of irritability but does not become tonically contracted. Symptoms may completely sub-

side or labor ensue without further complication. In those cases in which there is a definite progress of symptoms with increasing pain, shock, uterine tonicity or evidence of blood loss, promptly active treatment is imperative. The choice of active treatment will depend upon parity of the patient, the condition of the cervix, as to its retraction, dilatation and consistency, and the condition of the baby, as to its size, viability or possible intra-uterine death.

When the symptoms are increasing or when there is no improvement from the milder symptoms, the indications are to empty the uterus promptly with as little trauma to mother and baby as is consistent with the condition present. If vaginal delivery is chosen, several methods are available:

1. Rupture of the membranes plus the administration of fractional repeated doses of anterior pituitary extract or pitocin and await the progress of labor either spontaneous or with forceps delivery.

2. Rupture of the membranes plus the insertion of a hydrostatic bag with the administration of fractional doses of anterior pituitary extract.

To either of these methods a tight abdominal binder of the Spanish windlass type may be added.

3. Internal podalic version. This has very limited use and must be restricted to the patient with a completely dilated or easily negotiable cervix. It should never be performed in a tonic uterus and if chosen at all should be reserved for the patient with a small and often dead fetus.

It must be further recognized that if vaginal delivery is chosen as a method of treatment in the management of premature separation of placenta, the obstetrician must be constantly in attendance. He must be alert to the physical condition of the patient and able to gauge accurately the progress of labor as well as the condition within the uterus, since hemorrhage may continue beneath the placenta and infiltrate into the uterine musculature with inevitable production of the uteroplacental apoplexy of Courvelaire. In this condition the uterus becomes deep purple, completely tonic, often with tears in the peritoneal surface and extravasation of blood into the peritoneal cavity either through the tears or through the tubes. Such a uterus will not recover and return to normal following delivery.

While these changes are taking place the patient shows increasing shock, evidence of severe anemia and peritoneal irritation. When symptoms are increasing, attempt at vaginal management and delivery must

be abandoned and abdominal delivery carried out at once in the interests of the mother. Under such conditions the child in all probability is already dead, although if abdominal delivery is selected promptly fetal salvage may still be possible.

The failure of labor to be initiated or to progress satisfactorily has led many obstetricians to select abdominal delivery as a method of choice in an increasing number of cases of premature separation of placenta. This is particularly true in primigravidas or in all cases in which the baby is viable and living when the patient presents herself for treatment.

In many cases the cervix is thick, firm and undilated, hence not favorable for the prompt induction of labor and vaginal delivery. There is a great increase of fetal loss and often progressive blood loss in the mother together with infiltration and destruction of the uterine musculature during this waiting period. The general condition of the patient becomes progressively worse and the risk of delivery whether vaginal or abdominal increases proportionately. For these reasons our clinic has selected prompt abdominal delivery in all the more severe cases of premature separation of placenta and in many of the less severe but definite cases of premature separation especially in the primigravidas or in the multipara in whom the cervix seems unfavorable for prompt induction of labor and vaginal delivery. No method of delivery should be attempted until the mother has recovered sufficiently from shock through the administration of glucose, plasma and blood as indicated, and with opium or its derivatives for the control of pain. In many cases there is marked tendency to hemorrhage following emptying of the uterus either from above or below. This hemorrhage can usually be controlled by the routine use of anterior pituitary extract and ergotrate administered intramuscularly or intravenously. Tight uterine tamponade with heavy iodoform gauze is efficacious in most instances.

If, however, all attempts to control the hemorrhage fail, no time should be lost in performing a prompt abdominal hysterectomy, the patient being supported by repeated blood transfusions. As in placenta previa, blood transfusion, not only during but following delivery, is of paramount importance. The obstetrical surgeon must realize that continued blood loss and prolonged shock place the patient in such a depressed and critical condition that recovery becomes impossible, in spite of blood replacement. In these tragic cases the obstetrician must

make an important decision. If hysterectomy is to be done, it must be performed before the patient is depleted and in severe shock. Maternal life will be saved by the courageous surgeon who places a higher valuation on the life of the mother than upon the conservation of the uterus for possible future childbearing.

In our clinic, hysterectomy has been reserved for a small group of cases in which there was a severe type of uteroplacental apoplexy of Courvelaire or for cases in which there was uncontrollable hemorrhage following the emptying of the uterus. If the uterus shows ability to contract after it has been completely emptied, even though there is considerable infiltration of the uterine musculature with blood, the uterus will recover completely and may be safely retained. Several instances are recorded in which the mother has had subsequent pregnancy and delivery of a living child, usually by repeated caesarean section.

Laceration of Birth Canal and Ruptured Uterus

Hemorrhage due to laceration of the birth canal manifests itself usually immediately following the birth of the child. Such hemorrhages may be of a very minor degree and easily controlled by prompt repair. These hemorrhages may follow normal spontaneous labor and spontaneous delivery. Instrumental delivery, version and breech extraction or any of the more difficult types of vaginal delivery predispose to birth canal injury with its subsequent hemorrhage. The best treatment of hemorrhage from birth canal injuries is prevention. No vaginal delivery should be attempted until the cervix is fully dilated and retracted. Instrumental delivery must not be attempted until the head is engaged in the pelvis. No method of vaginal delivery should be attempted until the obstetrician is convinced that major disproportion between the fetus and the maternal birth canal does not exist. An accurate diagnosis as to presentation and position of the presenting part is an essential requisite before operative vaginal delivery is attempted. During her labor, the mother must have been properly supported and prepared by the maintenance of fluid intake, preferably by the intravenous route, and by blood transfusion, in those patients in whom marked anemia exists at the onset of labor. Manual dilatation of the cervix or incision of the cervix carries grave risk of hemorrhage post partum. These procedures have been discontinued by many obstetrical clinics. If done at all, they

must be done only after careful review of all the factors involved. Under these conditions the patient must, of course, receive prompt supportive treatment, blood replacement and shock therapy. Further operative procedures should be carried out only after the patient has responded to these measures.

Following the emptying of the uterus, if there is unusual bleeding, a complete exploration of the birth canal is indicated. Proper delivery room equipment with an adequate delivery table, proper lighting facilities and instruments for exposure of the genital canal are prime requisites. Under strict aseptic precautions the perineal area is carefully inspected and all damage noted. The cervix should be fully exposed and if tears are present these can and should be repaired by suture. Packing is usually inefficient and should be relied upon only when the patient's condition is such that further immediate operative procedures can not be carried out.

Rupture of the uterus, either before or during delivery, may manifest only minor external bleeding while there is evidence of blood loss and shock out of proportion to the external bleeding. The best treatment for rupture of the uterus, as in other childbirth injury, is prevention. Patients who have had extensive operations on the uterus from previous myomectomies, previous caesareans, etc. should not be allowed to undergo the strain of labor. The dictum, "Once a caesarean, always a caesarean," is probably an excellent one. It is possible, however, that previous caesareans may have been done for placenta previa in women who have an adequate pelvis with no obstruction in the soft parts and without fetal disproportion. Under careful supervision of labor and with a favorable soft cervix, the presenting part well in the pelvis and a short labor, vaginal delivery may be indicated.

Prolonged labor without definite progress and advancement of the presenting part resulting in a thinning of the lower uterine segment and a formation of so-called Bandl's ring predisposes to rupture of the uterus. The use of oxytocic drugs, such as anterior pituitary substance, to hasten the progress of labor and force the expulsion of the fetus is a frequent cause of uterine rupture. The use of oxytocics before the birth of the baby must be undertaken only after the careful evaluation of all conditions present. Many obstetricians forbid the use of oxytocics until the birth of the baby. If used at all, fractional doses repeated only at intervals and for a very limited time are allowable. Oxytocics must

not be used in any labor in which there is even a minor degree of disproportion. They should never be used in the presence of abnormal presentation.

Attempts at operative delivery through an incompletely dilated and retracted cervix are a major contributing factor to extensive cervical laceration and rupture of the lower uterine segment. Version and breech extraction, particularly in the uterus after prolonged ruptured membranes or in a uterus that is tonically contracted, are a frequent cause of uterine rupture. Attempts at instrumental rotation high in the pelvis, particularly, if the cervix is incompletely dilated, may result in rupture of the lower uterine segment.

If uterine rupture is suspected or diagnosed prior to the birth of the child, no attempt should be made at vaginal delivery. Delivery should be accomplished through the abdomen after proper supportive treatment to the mother and with adequate blood and plasma available at operation and post delivery. Many cases of uterine rupture are not diagnosed post delivery, particularly in those cases which show only a small amount of vaginal bleeding. These patients are frequently returned to their beds and in a short time or in a few hours show evidence of shock or blood loss or peritoneal irritation. Frequently these patients receive treatment both too little and too late for maternal salvage. These tragedies could be avoided if careful evaluation of the conditions had been made immediately post delivery. All patients who have had any of the more difficult or complicated vaginal operative deliveries such as instrumental rotation, difficult forceps, face presentation deliveries, version and extraction or breech deliveries or who have had prolonged and difficult labor should have careful immediate post partum examination. As soon as the uterus has been emptied of baby and placenta, careful inspection should be carried out under aseptic precautions and in a well equipped delivery room with all needed equipment available. The freshly gloved hand should explore the genital tract from perineum to fundus. I believe that this exploration should start at the fundus. Particular attention should be given to the lower uterine segment and to the cervix. This should be not only palpated but visualized. If lacerations in the cervix extend deeply into the fornices, these may be repaired by suture and the vagina subsequently tightly packed with iodoform gauze. If lacerations extend deeply into the lower uterine segment or an actual rupture is found in the uterus, the patient should be immedi-

ately subjected to laparotomy. Naturally, this operation should not be made in the presence of shock. The patient must be supported and restored by free administration of blood and plasma. At the time of laparotomy only the more minor degrees of injury to the uterus should be repaired by suture. All more major injuries will necessitate hysterectomy for the control of bleeding and the prevention of infection. Maternal mortality from ruptured uterus has been greatly lessened in all clinics where this apparently more radical treatment has been the method of choice.

Uterine Atony

Postpartum hemorrhage may occur following an apparently normal delivery, such hemorrhage not being due to trauma in any form. This may occur in the absence of any lacerations. This hemorrhage occurs as a rule shortly after delivery although it may occur later in the puerperium. Uterine fibroids interfering with the proper separation of the placenta or complete contraction of the uterine musculature following delivery, predispose to such hemorrhage. Prolonged labor or inefficient uterine contractions predispose to postpartum hemorrhage. Overdistention of the uterus due to twins or hydramnion may be a factor in postpartum hemorrhage. Incomplete separation of the placenta or retained fragments of placenta are causes of postpartum bleeding. A rare but dramatic cause of postpartum bleeding is puerperal inversion of the uterus. Treatment of these conditions will vary somewhat as to the cause of bleeding. Preventive treatment is of prime importance. Supportive treatment of the mother during delivery, particularly with parenteral fluids, blood and plasma if indicated, help to maintain tonicity of the uterus. The excessive use of various analgesics during labor must be carefully guarded against. Textbooks on obstetrics for many years have taught that the placenta should not be expressed for some time, usually from fifteen to twenty minutes or even one hour following the birth of the baby. It would seem that the placenta is separated much earlier than this and that blood loss is greatly lessened by its prompt removal. Certainly, in all cases following unusual or continued bleeding following the birth of the baby, the placenta and membranes should be removed promptly. Under careful aseptic technique in a well equipped, modern delivery room, manual exploration of the uterus is safe immediately following the birth of the baby. This should always be done if the

placenta is not and cannot be promptly expressed. Many clinics are now using preparations of ergot, such as ergotrate, ergonovine or posterior pituitary extract or a combination of both immediately following the birth of the baby. Some obstetricians give intravenous ergotrate as soon as the shoulders are in the introitus. The contraction which follows this probably separates the placenta along with the birth of the baby. In such instances the placenta is either expressed spontaneously or by a gentle pressure on the fundus. The already separated placenta is easily expressed from the cervix and vagina. Further intramuscular ergotrate preparations tend to maintain the tonicity of the uterus. Forcible attempts to express the placenta, especially if the uterus is not contracted, or traction upon the cord may tend toward inversion of the uterus. When acute inversion of the uterus occurs, there is usually profuse hemorrhage and rapid development of shock in the mother. Under these conditions the placenta has usually been separated and removed and the fundus will be found inverted within the vagina or protruding through the introitus. Prompt supportive measures must be instituted with blood and plasma. If the patient is not in shock, gentle attempts at manual replacement are justified and indicated. Should these attempts fail or increased shock symptoms supervene, attempts at replacement must be abandoned and the bleeding controlled, if possible, by tight tamponade. Increased efforts at combating shock are continued with heat, sedation and blood replacement. When the patient has recovered from her shock, attempts may be made, under anesthesia, to replace the uterus manually per vagina. If successful, the uterus and vagina are then packed. If attempts at manual replacement are unsuccessful, abdominal operation will be necessary for the correction of the condition. This should not be done until the patient is sufficiently recovered and is in condition for the operation. This may be from several hours to several days. In all cases in which there is excessive vaginal bleeding or lacerations or inversion of the uterus, bleeding should be controlled before the patient is returned to her bed. Careful exploration of the uterus, complete manual removal of all placental tissue if needed, and the insertion of tight uterine tamponade usually control this bleeding. There are a number of obstetricians who believe that uterine packing is completely inefficient and may even interfere with the proper contraction of the uterus. These men rely on complete emptying of the uterus and administration of oxytocics. In any event,

the patient must be properly supported with fluids and especially blood and plasma. If, in spite of all attempts to control the postpartum bleeding by the above methods, there is continued blood loss, the obstetrician must make a very important decision. Certainly, blood loss must be stopped. Under such conditions prompt abdominal hysterectomy will save maternal life. Too often this life saving operation is delayed to the point where the mother cannot recover, in spite of sufficient blood replacement and control of hemorrhage.

Bleeding during the puerperium may occur from retained fragments of placenta or from other uterine pathology, such as fibroids and the so-called subinvolution of the uterus. If this bleeding becomes alarming, proper methods must be instituted for its control. Placental fragments should be removed by a careful digital and instrumental curettage. Uterine fibroids rarely may necessitate abdominal hysterectomy. A rare cause of postpartum hemorrhage, namely placenta accreta, will have been determined in the time when the patient is examined because of failure of the expulsion of the placenta. If the placenta accreta is complete no significant bleeding will occur since bleeding occurs only after partial separation. Attempts at manual removal of the placenta indicate that there is no normal plane of cleavage between the placenta and the uterine musculature. Under such conditions, continued attempts to separate the placenta may result in perforation of the uterus by the examining fingers. Apparently hysterectomy is the only safe method of treatment in cases of true placenta accreta. Fortunately, this condition is rare.

In review, it would seem that if we are to reduce maternal mortality due to hemorrhage we should, insofar as is possible, prevent undue blood loss and if in spite of our efforts blood loss is unavoidable, prompt measures for its control and replacement must be available and utilized. During the pregnancy, the mother should be maintained in the best possible physical condition through proper diet, administration of calcium, iron, vitamins and blood transfusion, if necessary, to combat severe anemias. Early in her pregnancy, the patient should have not only a general and obstetrical check-up, she should also have blood Wassermann, blood typing, hemoglobin or red blood cell estimation and Rh factor determination. The patient should carry with her at all times and take with her to the hospital a record of her hemoglobin, Wassermann, blood type and Rh factor. This simple procedure will save

much valuable time and possibly life itself should the occasion arise demanding blood replacement.

Patients in the viable period of pregnancy should have competent evaluation of all factors concerned with labor and delivery. During labor the mother should have proper supportive treatment with parenteral fluids, rest and blood or plasma if necessary. We must seek to avoid unduly prolonged labor. No attempt should be made at vaginal delivery until the cervix is fully dilated and retracted and the obstetrician is convinced that no major disproportion exists. Obstetricians should avoid the indiscriminate and excessive use of analgesics and anesthetics. There must be prompt recognition and investigation of all abnormal bleeding —ante partum, intra partum or post partum with early and complete emptying of the uterus following the birth of the baby. Careful selection of the method of delivery best suited to prevent or control bleeding in the individual patient is essential. Early and competent consultation with a qualified obstetrical surgeon should be sought in all cases of abnormal bleeding. Finally, an efficient and fully equipped delivery room organization, including an adequate supply of blood and plasma immediately available will prevent many maternal deaths now attributed to hemorrhage in the viable period of pregnancy.

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